doi:10.1111/j.0361-3666.2007.01000.x

Post-traumatic stress disorder and comorbid depression among survivors of the 1999 earthquake in Turkey

Ebru Salcioglu, PhD, Metin Basoglu, MD, PhD and Maria Livanou, PhD Section of Trauma Studies, Institute of Psychiatry, King's College London, University of London

This study examined the prevalence of post-traumatic stress disorder (PTSD) and comorbid depression some three years after the August 1999 earthquake in Turkey among a sample of 769 survivors relocated to a permanent housing site built for homeless survivors in the epicentre region. Time since trauma was 3.1 years for 81 per cent of the participants and 3.9 years for the remainder. Survivors were assessed using the Screening Instrument for Traumatic Stress in Earthquake Survivors, an easily administered self-rating scale with demonstrated validity. The estimated rates of PTSD and comorbid depression were 40 per cent and 18 per cent, respectively. Linear regression analyses showed that PTSD strongly related to fear during the earthquake, while depression related to loss of family members. These results suggest that catastrophic earthquakes have long-term psychological consequences and highlight the need for a cost-effective mental health care model for earthquake survivors.

Keywords: depression, earthquake, fear, post-traumatic stress disorder, Turkey

Introduction

Earthquakes are common natural disasters which might cause large-scale death and devastation. Considering only those earthquakes that killed more than 1,000 people, approximately 1.8 million people lost their lives in 108 earthquakes in the twentieth century (National Earthquake Information Center, 2000). The most common psychiatric conditions seen among earthquake survivors are post-traumatic stress disorder (PTSD) and depression. In community samples that used random or consecutive sampling the rates of PTSD ranged from 2–43 per cent in the first year following an earthquake (Basoglu, Salcioglu and Livanou, 2002; Carr et al., 1995; Durkin, 1993; McMillen, North and Smith, 2000; Wang et al., 2000), and 3–50 per cent in the second year (Armenian et al., 2000; Basoglu et al., 2004; Durkin, 1993; Salcioglu, Basoglu and Livanou, 2003). The rates of depression across these periods ranged from 7–22 per cent (Basoglu, Salcioglu and Livanou, 2002; McMillen, North and Smith, 2000; Durkin, 1993) and 11–52 per cent (Armenian et al., 2000; Basoglu et al., 2004; Durkin, 1993; Salcioglu, Basoglu and Livanou, 2003), respectively. There are several reasons that account for this variability in the prevalence rates of psychopathology: lower morbidity rates were found in industrialised countries (that is, Australia and the United States), which suffered less devastation because of the pre-disaster structural quality of houses and because post-disaster rescue and relief efforts were superior to those in developing nations;

Disasters, 2007, 31(2): 115–129. © 2007 The Author(s). Journal compilation © Overseas Development Institute, 2007.
Published by Blackwell Publishing, 9600 Garsington Road, Oxford, OX4 2DQ, UK and 350 Main Street, Malden, MA 02148, USA

studies that used consecutive sampling yielded higher prevalence rates because they were conducted in survivor shelters, which usually accommodated more severely traumatised populations; and prevalence rates based on self-rated symptom checklists were higher than those based on structured interviews. To our knowledge, no study to date has reported morbidity rates beyond two years in community samples of earthquake survivors.

Few studies have examined the course of PTSD among earthquake survivors. Following the 1989 earthquake in Newcastle, Australia, PTSD rates decreased from 40 to 19 per cent in a high exposure group between six months and two years post-disaster and from 11 to 3 per cent in the low exposure group (Carr et al., 1997a). Earthquake-related morbidity rates in this sample stabilised at approximately 18 months post-disaster. A longitudinal study involving two assessments at 1.5 and 4.5 years after the 1988 Armenian earthquake showed a decline in PTSD rates from 86.7 to 73.3 per cent in the high exposure group and from 13.8 to 6.9 per cent in the low exposure group (Goenjian et al., 2000). This study, however, was based on a relatively small convenience sample of 36 survivors. PTSD rates remained unchanged among a low exposure group of 1998 north China earthquake survivors assessed three to nine months after the trauma event (22.7 per cent), although there was an increase in the high exposure group (8.5 to 14.3 per cent) (Wang et al., 2000). Finally, in two studies involving large samples of survivors of the 1999 earthquake in Turkey (1,586 cases in total), the estimated rate of PTSD was found to be 43 per cent 10 months after the disaster (Basoglu, Salcioglu and Livanou, 2002), declining to only 39 per cent after 20 months (Salcioglu, Basoglu and Livanou, 2003). So far, therefore, research suggests that PTSD is persistent among earthquake survivors. Nonetheless, more studies are needed to clarify the long-term course of PTSD and its symptomatology among survivors of devastating earthquakes.

Commonly reported PTSD risk factors among earthquake survivors include: female gender (Basoglu, Salcioglu and Livanou, 2002; Carr et al., 1997b; de la Fuente, 1990; Durkin, 1993; Livanou et al., 2002; Salcioglu, Basoglu and Livanou, 2003; Sharan et al., 1996); older age at trauma (Carr et al., 1995; 1997b; Salcioglu, Basoglu and Livanou, 2003); low level of education (Armenian et al., 2000; Basoglu, Salcioglu and Livanou, 2002; de la Fuente, 1990); past psychiatric problems (Basoglu, Salcioglu and Livanou, 2002; Nolen-Hoeksema and Morrow, 1991; Salcioglu, Basoglu and Livanou, 2003); degree of exposure to earthquake (Armenian et al., 2000; Carr et al., 1997b; Goenjian et al., 1994); fear during the earthquake (Basoglu, Salcioglu and Livanou, 2002; Basoglu et al., 2004; Livanou et al., 2002; Salcioglu, Basoglu and Livanou, 2003); having been trapped under rubble and participation in rescue work (Basoglu, Salcioglu and Livanou, 2002; Salcioglu, Basoglu and Livanou, 2003); loss of first degree-relatives (Basoglu, Salcioglu and Livanou, 2002; Basoglu et al., 2004; Goenjian et al., 1994; Livanou et al., 2002; Salcioglu, Basoglu and Livanou, 2003); loss of property (Armenian et al., 2000; Bland et al., 1996; Livanou et al., 2002; Sharan et al., 1996); loss of resources (Carr et al., 1995; Freedy et al., 1994); disruption to social network (Bland et al., 1997); and lack of governmental support post-trauma (Wang et al., 2000). Despite their methodological differences, these studies provided reasonably consistent evidence of PTSD risk factors among earthquake survivors.

Meanwhile, few studies have evaluated risk factors for depression among earthquake survivors. Those that have reported female gender, past psychiatric illness, death of a family member (Livanou et al., 2002; Salcioglu, Basoglu and Livanou, 2003), financial loss, not receiving assistance and post-disaster support (Armenian et al., 2002) as significant predictors of depression in earthquake survivors. Scrutiny of PTSD and depression risk factors is important in selecting appropriate treatment approaches for disaster survivors suffering from these psychiatric conditions.

On 17 August 1999, an earthquake measuring 7.4 on the Richter scale occurred in Turkey, the epicentre of which was near the town of Gölcük in the region of Marmara. According to Government Crisis Centre reports, more than 95,000 houses were reduced to rubble or severely damaged and 18,243 people died. The earthquake left some 250,000 people homeless and incurred a loss of USD 20 billion in property and production. Hundreds of aftershocks followed this earthquake. In previous community-based studies we reported prevalence of PTSD and depression first among survivors relocated to temporary shelters (such as tent camps and prefabricated houses) (Basoglu, Salcioglu and Livanou, 2002; Salcioglu, Basoglu and Livanou, 2003), and second among those who continued to live in their own houses (Basoglu et al., 2004). This paper is based on a study of a group of survivors moved to a government-built 'permanent housing site'. The study aimed to examine rates of PTSD and depression three years after the 1999 earthquake in Turkey. The expectation was that rates of PTSD and depression would still be elevated at a mean of three years after the disaster.

Methods

The study was part of a five-year mental health care project implemented in 15 project sites following the 1999 earthquake in Turkey. The aim was to develop a brief and effective treatment for earthquake-related traumatic stress problems and to disseminate it to survivors in the community.

Participants

The participants were recruited from the Sirinköy housing site in the epicentre zone (Gölcük), which the government constructed for around 7,000 adult survivors whose houses had either collapsed or sustained severe damage. This was the largest housing site in the epicentre region. Inclusion criteria included experience of the 17 August earthquake in the epicentre area, an age of between 15 and 75 years, literacy, and absence of severe physical or mental cognitive impairment that would significantly interfere with the assessment.

The Sirinköy housing site comprised 38 apartment blocks containing a total of 3,604 flats. Screening was discontinued after 1,271 households in the first 18 apartment blocks had been contacted because treatment service delivery at this site was terminated due to a lack of funding. As 211 (16.6 per cent) of these flats were still uninhabited, the number of households available for contact was in fact 1,060. The rate of success

in contacting the 1,060 households was 70.1 per cent (n=743). Failure (n=317) stemmed from the fact that inhabitants were not at home on two separate visits. Of the 743 households successfully contacted, 131 (17.6 per cent) were ineligible for screening because of old age, illiteracy or not having experienced the earthquake in the epicentre zone, and 168 (22.6 per cent) refused to take part in the assessment. Of the latter, 114 (67.8 per cent) said that they did not have any earthquake-related psychological problems or that they did not need a psychological assessment, 12 (7.1 per cent) did not want to talk about the earthquake or stated they did not have time for the evaluation, while 33 (19.6 per cent) did not offer any reason for refusal. Overall, 444 (59.8 per cent) households were screened. The total number of survivors screened in these households was 774.

Procedure

Random sampling was not attempted because the study was part of a service delivery programme that sought to screen the whole housing site population, identifying those in need and providing psychological treatment. Three psychologists and a psychiatrist visited the houses consecutively; if they could not find the inhabitants after two attempts they moved on to the next household. Data collection took place between 21 June 2002 and 17 September 2003, a mean of 40 months/3.3 years after the earthquake. Eighty-one per cent of the participants were screened between June 2002 and January 2003 (3.1 years) and 19 per cent between May and September 2003 (3.9 years).

Measures

The assessment was conducted using the Screening Instrument for Traumatic Stress in Earthquake Survivors (SITSES) (Basoglu et al., 2001). We selected to use SITSES because it was an easily administered self-rating scale with demonstrated validity, which assessed PTSD specific to earthquake trauma. Employment of this scale also made possible a comparison of the results across our studies. SITSES comprised three parts. First, the 28-item Survivor Information Form (SIF) yielded information on demographic, personal history and trauma characteristics:

- age, gender, education (1=*literate,* 5=*university/postgraduate education*);
- marital status (0=*single/divorced/widowed,* 1=*married*);
- past psychiatric illness, family history of psychiatric illness, past trauma experience, having been trapped under rubble, loss of first-degree relatives, second-degree relatives, friends and/or neighbours, or property, and participation in rescue work (all coded as 0=*no,* 1=*yes*);
- location during the earthquake (0=*not in a building,* 1=*outside*);
- level of damage to home (1=*no damage,* 2=*minimal,* 3=*moderate,* 4=*severe,* 5=*collapsed*); and
- fear during the earthquake (0=*none,* 4=*extremely severe*).

The second part, the Traumatic Stress Symptom Checklist (TSSC), included 17 DSM-IV PTSD and six depression symptoms experienced in the preceding week, all measured on an intensity scale (0=*not at all bothered,* 3=*very much bothered*).

The third part, the Severity of Disability Scale (SDS), consisted of two items designed to measure global severity of distress (how distressed/bothered are you by the problems listed above?; 0=*not at all,* 3=*extremely*) and the degree of disability in terms of work, family and social functioning (how impaired/limited is your work, family life and relationships with others because of the problems above?; 0=*not at all,* 3=*extremely*).

The TSSC was validated (Basoglu et al., 2001) against the Clinician-Administered PTSD Scale (CAPS) (Blake et al., 1990) and the major depressive episode (MDE) module of the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID) (First et al., 1996). For the diagnosis of PTSD the optimal cut-off point was 25 in the total scores of the 17 PTSD items (sensitivity 0.81, specificity 0.81; overall correct classification rate 81 per cent). For the diagnosis of depression, the optimal cut-off point was 38 in the total scores of the 23 TSSC items (sensitivity 0.83, specificity 0.73; overall correct classification rate 77 per cent). One should note that the TSSC diagnoses depression only when the diagnosis of PTSD is met. Hence, it cannot single out cases of depression in the absence of PTSD.

Data analyses

Prior to analysis, data were checked for missing values. Five cases were deleted from the analysis because they had more than three missing values on the TSSC. Consequently, 769 cases were available for the analysis. Chi-square tests were used for categorical and t-tests for continuous variables. Based on our previous findings (Livanou et al., 2002; Salcioglu, Basoglu and Livanou, 2003), a factor analysis of the TSSC (principal axis factoring with Varimax rotation) was conducted to obtain uncorrelated measures of PTSD and depression. The respondents' scores on the TSSC factors were then computed for use in subsequent analyses. Hierarchical linear regression analyses were performed to examine the predictors of PTSD and depression, using, in turn, the TSSC factor scores as the dependent variables.

Results

Sample characteristics

Table 1 shows the sample characteristics. The sample represented the most common types of earthquake-related traumatic events. These were not mutually exclusive as some survivors experienced more than one type of traumatic event (for instance, 45 per cent of the survivors trapped under rubble reported loss of a first-degree relative). Women were predominant in the sample (66 per cent) because staff operated during the day when men were at work. Compared with men women were younger and more likely to be married, and they had less education, and more personal and family history of psychiatric illness and past trauma experience. They also reported fewer instances of being trapped under rubble, participation in rescue work, property loss, and greater fear during the earthquake. These differences were consistent with our previous findings (Basoglu, Salcioglu and Livanou, 2002; Salcioglu, Basoglu and Livanou, 2003).

Table 1 Sample characteristics (N = 769)

	Total				Males (n = 262)				Females (n = 507)						
Variables	**M**	**SD**	**n**	**%**	**M**	**SD**	**n**	**%**	**M**	**SD**	**n**	**%**	**df**	**χ^2**	**t**
Demographic and personal history characteristics															
Age	36.1	13.3	–	–	39.0	14.1	–	–	34.6	12.7	–	–	477.9	–	4.2***
Education (1–5)[a]	3.1	1.1	–	–	3.5	1.0	–	–	3.0	1.1	–	–	560.9	–	6.9***
Marital status (married)	–	–	569	74	–	–	206	79	–	–	363	72	1	4.1*	–
Past psychiatric illness	–	–	66	9	–	–	11	4	–	–	55	11	1	8.6**	–
Psychiatric illness in the family	–	–	48	6	–	–	8	3	–	–	40	8	1	6.1*	–
Previous trauma experience	–	–	140	18	–	–	65	25	–	–	75	15	1	10.2***	–
Trauma characteristics															
Trapped under rubble	–	–	164	21	–	–	69	26	–	–	95	19	1	5.4*	–
Lost family members	–	–	147	19	–	–	54	21	–	–	93	19	1	0.4	–
Lost second-degree relatives	–	–	424	55	–	–	142	55	–	–	282	57	1	0.2	–
Lost friends and/or neighbours	–	–	664	86	–	–	235	90	–	–	429	87	1	1.9	–
Participated in rescue work	–	–	261	34	–	–	161	63	–	–	100	20	1	136.6***	–
Lost property	–	–	532	69	–	–	202	78			330	66	1	11.3***	–
Extent of damage to home (1–5)[b]	4.0	1.3	–	–	4.1	1.3	–	–	4.0	1.3	–	–	738	–	1.6
Intensity of fear (0–4)[c]	3.1	1.1	–	–	2.8	1.2	–	–	3.3	1.1	–	–	467.9	–	5.2***
Time since earthquake (years)	3.3	0.4	–	–	3.3	0.3	–	–	3.2	0.4	–	–	767	–	2.1*

Notes

M = mean, SD = standard deviation, n = sample size, % = per cent, df = degrees of freedom, χ^2 = Chi square, t = independent samples t-test t value

[a] 1 = literate, 2 = primary school, 3 = secondary school, 4 = high school, 5 = university/postgraduate studies

[b] 1 = no damage, 2 = minimal damage, 3 = moderate damage, 4 = severe damage, 5 = collapsed

[c] 0 = none, 1 = slight, 2 = marked, 3 = severe, 4 = extremely severe

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

As the participants were screened at two different time points during the study (June 2002–January 2003 and May–September 2003), the survivors screened later in the process were compared to those screened earlier. There were no significant differences between the two groups in relation to any demographic and trauma characteristics.

Prevalence of PTSD and depression

The estimated rates of PTSD and depression were 40.1 per cent and 27.3 per cent, respectively. Overall, 67.5 per cent of the survivors with PTSD had comorbid depression. Compared with men, women had a significantly higher estimated rate of PTSD, 27.9 per cent versus 46.4 per cent, χ^2 (1, N = 769) = 23.82, $p < 0.001$, and depression, 18.3 per cent versus 32 per cent, χ^2 (1, N = 769) = 15.49, $p < 0.001$. As women were predominant in the sample, the rates of PTSD and depression were adjusted for gender. The respective rates were 37.2 per cent and 25.2 per cent.

Because our study sample included more than one person from 235 (52.8 per cent) of the households screened, familial factors might have led to an overestimation of PTSD and depression. To rule out this possibility, one survivor from each household was randomly selected and the analyses were repeated for this new sample (n = 443). The respective rates for PTSD and depression were 42.7 per cent and 27.8 per cent.

The fact that data collection took place at two different points might have inflated the prevalence rates, if the latter declined over time. To examine this possible time effect, the estimated rates of PTSD and depression at these two points were compared. The respective estimated rates of PTSD were 41.3 per cent and 34.7 per cent, (χ^2 (1, N = 769) = 1.8, p = 0.18), and those of depression were 29.1 per cent and 19.4 per cent (χ^2 (1, N = 769) = 5.04, $p < 0.05$). Morbidity rates thus declined over time, which was not statistically significant for PTSD but was significant for depression.

Subjective distress and disability

On the SDS, 303 (40.4 per cent) of the participants reported '*fairly severe*' or '*extremely severe*' subjective distress related to traumatic stress symptoms, whereas 166 (21.5 per cent) reported '*fairly*' or '*extremely*' impaired social/occupational/family functioning. Both subjective distress and functional impairment correlated highly with the TSSC total score (r = 0.73, $p < 0.001$ and r = 0.72, $p < 0.001$, respectively).

Factor analysis of the TSSC

A factor analysis of the TSSC yielded two factors, which were then rotated orthogonally (Varimax) for a meaningful solution (Table 2). This analysis achieved a reasonably clear separation between PTSD and depression symptoms, except for those common to both disorders (for example, loss of interest, memory and concentration problems, irritability). The compositions of the two factors were very similar to those observed in our previous studies (Basoglu, Salcioglu and Livanou, 2002; Livanou et al., 2002; Salcioglu, Basoglu and Livanou, 2003). The respondents' scores on each factor were computed for use in regression analyses.

Table 2 Factor analysis of the Traumatic Stress Symptom Checklist

TSSC symptoms	Factor 1	Factor 2
Flashbacks	0.70	0.29
Intrusive memories	0.69	0.27
Hypervigilance	0.68	0.28
Startle	0.67	0.32
Distress when reminded of the trauma	0.67	0.37
Avoidance of trauma reminders	0.66	0.33
Physiological reactivity	0.64	0.42
Avoidance of trauma thoughts	0.64	0.31
Nightmares	0.59	0.33
Insomnia	0.51	0.39
Irritability	0.51	0.51
Psychogenic amnesia	0.35	0.35
Emotional numbing	0.35	0.77
Loss of pleasure	0.38	0.76
Hopelessness	0.29	0.73
Detachment	0.29	0.71
Loss of interest	0.42	0.71
Depressed mood	0.44	0.64
Loss of energy	0.40	0.63
Memory/concentration difficulty	0.49	0.52
Sense of foreshortened future	0.43	0.50
Suicidal thoughts	0.18	0.48
Guilt feeling	0.23	0.46
Eigen value	**6.0**	**6.0**
Total variance explained	**26%**	**26%**

Predictors of PTSD and comorbid depression

Two hierarchical linear regression analyses were performed using the PTSD and depression factor scores as dependent variables. The dichotomous measures of PTSD/non-PTSD and depression/non-depression were not selected because the TSSC was able to diagnose only depression comorbid to PTSD. Consequently, the factor scores were used to examine the possible differential predictions on PTSD and depression symptoms.

The independent variables were selected from the SIF and included the common risk factors for PTSD reported in the literature: age, gender, education, marital status, past psychiatric illness, family history of psychiatric illness, past trauma experience, having been trapped under rubble, loss of first-degree relatives, loss of second-degree

relatives, loss of friends and/or neighbours, property loss, participation in rescue work, damage to home, number of days since the trauma, and fear during the earthquake. As there was some overlap between the PTSD and depression factors of the TSSC, the two factors' scores showed some correlation with each other ($r = 0.15, p < 0.001$). To control for the possible confound of this shared variance, PTSD and depression factor scores were included separately in each prediction analysis as independent variables.

The sequential entry method was employed to determine what each set of variables added to the regression equation at its own point of entry when the effects of other predictors were controlled for. PTSD or depression factor scores were entered at Step 1, background characteristics at Step 2, trauma characteristics at Step 3, and fear during the earthquake at Step 4. Table 3 shows R^2 change, F and p values for the regression model at each step and for the full regression model for both analyses, and standardised regression coefficients (β) for the independent variables entered at the final step. In both analyses, all variables entered the equation without violating the default value for tolerance. Hence, there were no problems of multicollinearity.

In the analysis involving PTSD factor scores, the regression model was significant at each step. Demographic and personal history characteristics explained a similar proportion of the variance as did the trauma characteristics, and fear during the earthquake explained the highest proportion of the variance. In the full regression model, fear during the earthquake, female gender, having been trapped under rubble, lower education and loss of friends and/or neighbours predicted higher PTSD factor scores. Depression factor scores did not relate to PTSD.

In the analysis involving depression factor scores, demographic and trauma characteristics again explained a similar proportion of the variance. However, fear during the earthquake, unlike in the analysis involving PTSD factor scores, explained the smallest proportion of the variance. In the full model, loss of family members, history of past psychiatric illness, lower education, and fear during the earthquake predicted higher depression factor scores. PTSD factor scores did not have a significant association with depression factor scores.

Hence, the shared variance in the dependent variables did not introduce a confound into the regression analyses. PTSD and depression symptoms related to different earthquake-related stressors. Female gender, having been trapped under rubble, and loss of friends and/or neighbours predicted PTSD but not depression, while loss of family members and history of past psychiatric illness predicted depression but not PTSD. Fear during the earthquake predicted both PTSD and depression, but its association with PTSD was stronger.

Discussion

Some methodological limitations should be borne in mind in interpreting the results. First, our results are based on a self-rated instrument that can estimate only the rates of PTSD and depression comorbid to PTSD with a margin of error. Second, as the study group was selected from a population with relatively high trauma exposure, the

Table 3 Multiple regression analysis of factors related to PTSD and depression symptoms

Regression model	PTSD			Depression		
Step 1[a]	R^2 change =	0.01, F (1, 651) =	9.23**	R^2 change =	0.01, F (1, 651) =	9.23**
Step 2[b]	R^2 change =	0.07, F (7, 644) =	7.29***	R^2 change =	0.04, F (7, 644) =	4.32***
Step 3[c]	R^2 change =	0.08, F (8, 636) =	7.08***	R^2 change =	0.04, F (8, 636) =	3.55***
Step 4[d]	R^2 change =	0.11, F (1, 635) =	91.55***	R^2 change =	0.01, F (1, 635) =	5.37*
Full regression model	Adjusted R^2 =	0.25, F (17, 635) =	13.59***	Adjusted R^2 =	0.08, F (17, 635) =	4.43***
Predictors at the last step	β			β		
PTSD/depression factor scores[a]	0.00			0.00		
Age	0.02			0.04		
Gender	0.16***			0.05		
Education	-0.10*			-0.10*		
Marital status	0.03			-0.04		
History of past psychiatric illness	0.05			0.11**		
Family history of psychiatric illness	-0.04			0.03		
Past trauma experience	0.07			0.07		
Having been trapped under rubble	0.15***			-0.06		
Loss of family members	0.03			0.16***		
Loss of second-degree relatives	0.04			0.05		
Loss of friends/neighbours	0.09**			0.05		
Loss of property	0.04			0.03		
Participation in rescue work	0.01			-0.05		
Damage to home	-0.01			0.05		
Time since the earthquake	0.00			-0.04		
Fear during the earthquake	0.35***			0.10*		

Notes

[a] Independent variables entered at Step 1: in the analysis involving PTSD factor scores as the dependent variable, depression factor scores were entered as an independent variable; in the analysis involving depression factor scores as the dependent variable, PTSD factor scores were entered as an independent variable.

[b] Independent variables entered at Step 2: age, gender, education level, marital status, history of past psychiatric illness, family history of past psychiatric illness, past trauma experience.

[c] Independent variables entered at Step 3: having been trapped under rubble, loss of family members, loss of second-degree relatives, loss of friends/neighbours, loss of property, participation in rescue work, damage to home, time since the earthquake.

[d] Independent variables entered at Step 4: fear during the earthquake.

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

results cannot be generalised to the whole population in the epicentre region. Although our sample was not randomly selected, there is no compelling reason to believe that it is biased in any way since the screening took place in a consecutive fashion. Similarly, the survivors we failed to screen because they were not at home at the time of our visits are unlikely to differ from our study participants. However, the relatively high refusal rate (23 per cent) could be a potential source of bias. Although two-thirds of those who refused to take part in the assessment stated that they did not have earthquake-related psychological problems, some of them may have declined to avoid distressing trauma memories. Nevertheless, even if we had included these cases in our sample, assuming that none of them had PTSD or depression at the time of the assessment, the adjusted rates of PTSD and depression in our sample would not have been substantially lower (33 per cent and 22 per cent, respectively). Then again, if refusal to participate was related to psychological problems, this sampling bias might have led to an underestimation of the rates of PTSD and depression in our sample (51 per cent and 40 per cent, respectively). In either case, our study results suggest elevated rates of PTSD and depression among earthquake survivors with high trauma exposure three years after the disaster.

The estimated rate of PTSD found in this study was 40 per cent. Taking into account that the TSSC overestimates the rate of depression by nine per cent (Basoglu et al., 2001), the rate of depression comorbid to PTSD in this sample is more likely to be around 18 per cent. In our previous studies (Basoglu, Salcioglu and Livanou, 2002; Salcioglu, Basoglu and Livanou, 2003) based on community samples drawn from survivor shelters, the respective rates of PTSD and depression were 43 per cent and 22 per cent in the first year after the earthquake and 39 per cent and 18 per cent in the second year. In as much as the present sample is comparable to the previous ones the estimated rates of PTSD and accompanying depression did not show a substantial decrease during the three years after the disaster. This is consistent with the evidence showing that earthquake-related morbidity rates tend to stabilise at around 18 months post-disaster (Carr et al., 1997a). Such high rates of chronic PTSD and comorbid depression may be explained by the large-scale death and destruction caused by the earthquake, difficult living conditions after the disaster, and the anticipatory fear fuelled by the expectation of yet another major earthquake in the same region (Basoglu, Salcioglu and Livanou, 2002; Salcioglu, Basoglu and Livanou, 2003).

The prevalence rates of PTSD and depression tended to decline between the study's two time periods (that is, 41 to 35 per cent for PTSD, and 29 to 19 per cent for depression). The start of the study almost coincided with the onset of distribution by the government of permanent accommodation at the beginning of 2002. Thus, at the time of assessment, the first group of survivors were just settling into their houses, while the second group of survivors had been living in their houses for around one year. We know from our field experience that living in a concrete building sometimes leads to self-instigated exposure to feared situations, such as staying alone in the house by day or at night, taking a bath alone in the house, and being or sleeping in the dark. We also know from four clinical trials (Basoglu, Livanou and Salcioglu,

2003a; Basoglu et al., 2003b; Basoglu et al., 2005; Basoglu, Salcioglu and Livanou, 2007) that such exposure helps survivors overcome their earthquake-related fears and to recover from PTSD and depression. This process could explain the decline of post-traumatic stress problems in earthquake survivors assessed at two different time points.

The factorial composition of the TSSC was replicated in this study one more time (Basoglu, Salcioglu and Livanou, 2002; Livanou et al., 2002; Salcioglu, Basoglu and Livanou, 2003). Symptoms of re-experiencing, cognitive and behavioural avoidance, and symptoms tapping hypervigilance clustered together, whereas the numbing and depressive symptoms loaded on a separate factor. This composition of symptoms is similar to the two-factor structure reported in recent factor analytic studies of PTSD (Buckley, Blanchard and Hickling, 1998; Taylor et al., 1998). The numbing and arousal symptoms that loaded on the second factor (that is, emotional numbing, detachment, sense of a foreshortened future, sleep difficulties, irritability, and memory and concentration difficulty) are very reminiscent of depression (Buckley, Blanchard and Hickling, 1998) and it is not surprising that they also clustered with the TSSC's depression symptoms. These results viewed together with evidence from our previous studies (Basoglu, Salcioglu and Livanou, 2002; Livanou et al., 2002; Salcioglu, Basoglu and Livanou, 2003) and from studies with other trauma populations (Buckley, Blanchard and Hickling, 1998; Foa, Riggs and Gershuny, 1995; Taylor et al., 1998) suggest that numbing symptoms should not be classified with avoidance symptoms in DSM-IV.

As in our previous studies (Livanou et al., 2002; Salcioglu, Basoglu and Livanou, 2003), PTSD was strongly associated with fear during the earthquake, while depression was related more to loss of family members. That fear during the earthquake is the most important risk factor for PTSD is a robust finding given that it predicted PTSD in our five studies (including the present one), which together involved 4,332 earthquake survivors (Basoglu, Salcioglu and Livanou, 2002; Livanou et al., 2002; Salcioglu, Basoglu and Livanou, 2003; Basoglu et al., 2004). This finding is also consistent with other evidence on the role of peritraumatic fear in the development of acute stress disorder in earthquake survivors (Bergiannaki et al., 2003). The retrospective rating of fear during the earthquake did not merely reflect a confound of PTSD symptoms, as it was shown to have external validity as a predictor variable in all of our previous studies. Greater fear during the earthquake was shown to be related to other variables, such as being in a building at the time of the earthquake, female gender, lower education, and being closer to the epicentre (Basoglu, Salcioglu and Livanou, 2002; Livanou et al., 2002; Salcioglu, Basoglu and Livanou, 2003).

Several explanations can be offered for the prediction between fear and depression. First, the shared variance resulting from the overlapping symptoms of PTSD and depression might be responsible for the prediction between fear and depression. Second, while depression might be due to bereavement in some earthquake survivors, it might be secondary to PTSD in others (Livanou et al., 2002). That 24 per cent of non-bereaved survivors in this sample had depression supports this point. Another form of evidence comes from a study (Salcioglu, 2004) involving 387 earthquake survivors assessed using the SCID (First et al., 1996). The results showed that 53 per cent of the survivors who

had PTSD also had depression, whereas only 17 per cent of the survivors without PTSD had depression. These findings support the view that depression is likely to occur secondary to PTSD in earthquake survivors. Secondary depression might be related to helplessness generated by (1) symptoms of chronic PTSD, (2) exposure to numerous unpredictable and uncontrollable aftershocks, and (3) anticipatory fear of future earthquakes (Basoglu et al., 2004).

The differential stressor–response relationship may have important implications for the choice of appropriate treatments for trauma survivors. Evidence from our clinical trials (Basoglu, Livanou and Salcioglu, 2003a; Basoglu et al., 2003b; Basoglu et al., 2005; Basoglu, Salcioglu and Livanou, 2007) shows that a behavioural intervention designed to enhance a sense of control over fear reduces both PTSD and depression. However, depression resulting from resource loss might require social support and compensation of losses. Depression related to loss of close ones might respond to behavioural interventions involving exposure to avoided reminders of the deceased (Mawson et al., 1981; Sireling, Cohen and Marks, 1988). There is also evidence from our clinical trial (Basoglu et al., 2003b) that exposure and response prevention strategies are effective in reducing grief symptoms in earthquake survivors.

Conclusion

The present study is the fourth in a series of four field surveys that shows elevated rates of chronic PTSD and depression among earthquake survivors in the long run. The study findings again highlighted the importance of planning long-term psychological interventions for after a major earthquake. Our recent clinical trials (Basoglu, Livanou and Salcioglu, 2003a; Basoglu et al., 2003b; Basoglu et al., 2005; Basoglu, Salcioglu and Livanou, 2007) demonstrated that PTSD and depression among earthquake survivors can be effectively treated with a single session of modified behavioural treatment, which involves mainly self-exposure instructions designed to enhance a sense of control of earthquake-related fears. Some preliminary evidence (Basoglu, Salcioglu and Livanou, submitted for publication) also suggests that this treatment can be disseminated in a cost-effective fashion to large numbers of survivors via a self-help manual. It is conceivable that the treatment can also be circulated though other media, such as video cassettes, computer programmes and even television channels, although the effectiveness of such means has yet to be confirmed. The outreach service delivery approach employed to access needy survivors, the screening instrument used to identify those in need of treatment, the single-session behavioural intervention, and the delivery of the treatment via a self-help manual could constitute the elements of an effective and cost-efficient mental health care model for earthquake survivors.

Correspondence

Ebru Salcioglu, DABATEM, Meselik Sok. 36/5, Sıraselviler, Beyoglu, Istanbul, Turkey. Telephone: +90 212 249 6949; fax: +90 212-245 2385; e-mail: E.Salcioglu@iop.kcl.ac.uk.

References

Armenian, H.K. et al. (2000) 'Loss as a determinant of PTSD in a cohort of adult survivors of the 1988 earthquake in Armenia: Implications for policy'. *Acta Psychiatrica Scandinavica*. 102. pp. 58–64.

Armenian, H.K. et al. (2002) 'Risk factors for depression in the survivors of the 1988 earthquake in Armenia'. *Journal of Urban Health: Bulletin of the New York Academy of Medicine*. 79(3). pp. 373–382.

Basoglu, M. et al. (2001) 'A study of the validity of a screening instrument for traumatic stress in earthquake survivors in Turkey'. *Journal of Traumatic Stress*. 14(3). pp. 491–509.

Basoglu, M., E. Salcioglu and M. Livanou (2002) 'Traumatic stress responses in earthquake survivors in Turkey'. *Journal of Traumatic Stress*. 15(4). pp. 269–276.

Basoglu, M., M. Livanou and E. Salcioglu (2003a) 'A single session with an earthquake simulator for traumatic stress in earthquake survivors'. *American Journal of Psychiatry*. 160(4). pp. 788–790.

Basoglu, M., M. Livanou, E. Salcioglu and D. Kalender (2003b) 'A brief behavioral treatment of chronic posttraumatic stress disorder in earthquake survivors: Results from an open clinical trial'. *Psychological Medicine*. 33(4). pp. 647–654.

Basoglu, M., C. Kilic, E. Salcioglu and M. Livanou (2004) 'Prevalence of posttraumatic stress disorder in earthquake survivors in Turkey: An epidemiological study'. *Journal of Traumatic Stress*. 17(2). pp. 133–141.

Basoglu, M., E. Salcioglu, M. Livanou, D. Kalender and G. Acar (2005) 'Single-session behavioral treatment of earthquake-related posttraumatic stress disorder: A randomized waitlist controlled trial'. *Journal of Traumatic Stress*. 18(1). pp. 1–11.

Basoglu, M., E. Salcioglu and M. Livanou (2007) 'A randomized controlled study of single-session behavioural treatment of earthquake-related post-traumatic stress disorder using an earthquake simulator'. *Psychological Medicine*. 37(2). pp. 203–213.

Basoglu, M., E. Salcioglu and M. Livanou (submitted for publication) 'The usefulness of a self-help manual in the treatment of post-traumatic stress disorder in earthquake survivors'.

Bergiannaki, J.D., C. Psarros, E. Varsou, T. Paparrigopoulos and C.R. Soldatos (2003) 'Protracted acute stress reaction following an earthquake'. *Acta Psychiatrica Scandinavica*. 107(1). pp. 18–24.

Blake, D.D. et al. (1990) 'A clinician rating scale for assessing current and lifetime PTSD: The CAPS-1'. *The Behaviour Therapist*. 13. pp. 187–188.

Bland, S., E.S. O'Leary, E. Farinaro, F. Jossa and M. Trevisan (1996) 'Long-term psychological effects of natural disasters'. *Psychosomatic Medicine*. 58(1). pp. 18–24.

Bland, S.H. et al. (1997) 'Social network disturbances and psychological distress following earthquake evacuation'. *Journal of Nervous and Mental Disease*. 185(3). pp. 188–194.

Buckley, T.C., E.B. Blanchard and E.J. Hickling (1998) 'A confirmatory factor analysis of posttraumatic stress symptoms'. *Behaviour Research and Therapy*. 36(11). pp. 1091–1099.

Carr, V.J. et al. (1995) 'Psychosocial sequelae of the 1989 Newcastle earthquake: I. Community disaster experiences and psychological morbidity 6 months post-disaster'. *Psychological Medicine*. 25(3). pp. 539–555.

Carr, V.J. et al. (1997a) 'Psychosocial sequelae of the 1989 Newcastle earthquake: II. Exposure and morbidity profiles during the first 2 years post-disaster'. *Psychological Medicine*. 27(1). pp. 167–178.

Carr, V.J. et al. (1997b) 'Psychosocial sequelae of the 1989 Newcastle earthquake: III. Role of vulnerability factors in post-disaster morbidity'. *Psychological Medicine*. 27(1). pp. 179–190.

de la Fuente, R. (1990) 'The mental health consequences of the 1985 earthquakes in Mexico'. *International Journal of Mental Health*. 19(2). pp. 21–29.

Durkin, M.E. (1993) 'Major depression and posttraumatic stress disorder following the Coalinga and Chile earthquakes: A cross-cultural comparison'. *Journal of Social Behavior and Personality*. 8(5). pp. 405–420.

First, M.B., R.L. Spitzer, M. Gibbon and J.B.W. Williams (1996) *Structured Clinical Interview for DSM-IV Axis I Disorders – Non-patient Edition (SCID-I/NP, Version 2)*. Biometrics Research Department, New York State Psychiatric Institute, New York, NY.

Foa, E.B., D.S. Riggs and B.S. Gershuny (1995) 'Arousal, numbing and intrusion: Symptom structure of PTSD following assault'. *American Journal of Psychiatry*. 152(1). pp. 116–120.

Freedy, J.R., M.E. Saladin, D.G. Kilpatrick, H.S. Resnick and B.E. Saunders (1994) 'Understanding acute psychological distress following natural disaster'. *Journal of Traumatic Stress.* 7(2). pp. 257–273.

Goenjian, A.K. et al. (1994) 'Posttraumatic stress disorder in elderly and younger adults after the 1988 earthquake in Armenia'. *American Journal of Psychiatry.* 151(6). pp. 895–901.

Goenjian, A.K. et al. (2000) 'Prospective study of posttraumatic stress, anxiety, and depressive reactions after earthquake and political violence'. *American Journal of Psychiatry.* 157(6). pp. 911–916.

Livanou, M., M. Basoglu, E. Salcioglu and D. Kalender (2002) 'Traumatic stress responses in treatment-seeking earthquake survivors in Turkey'. *Journal of Nervous and Mental Disease.* 190(12). pp. 816–823.

Mawson, D., I.M. Marks, L. Ramm and R.S. Stern (1981) 'Guided mourning for morbid grief: a controlled study'. *British Journal of Psychiatry.* 138(3). pp. 185–193.

McMillen, J.C., C.S. North and E.M. Smith (2000) 'What parts of PTSD are normal: Intrusion, Avoidance or Arousal? Data from the Northridge, California, Earthquake'. *Journal of Traumatic Stress.* 13(1). pp. 57–75.

National Earthquake Information Center (2000) 'Earthquakes with 1,000 or more deaths from 1900'. http://wwwneic.cr.usgs.gov/neis/eqlists/eqsmajr.html (accessed 14 May 2000).

Nolen-Hoeksema, S. and J. Morrow (1991) 'A prospective study of depression and posttraumatic stress symptoms after a natural disaster: The 1989 Loma Prieta earthquake'. *Journal of Personality and Social Psychology.* 61(1). pp. 115–121.

Salcioglu, E. (2004) *The effect of beliefs, attribution of responsibility, redress and compensation on posttraumatic stress disorder in earthquake survivors in Turkey*. Unpublished PhD dissertation, Institute of Psychiatry, King's College London, University of London.

Salcioglu, E., M. Basoglu and M. Livanou (2003) 'Long-term psychological outcome in non-treatment-seeking earthquake survivors in Turkey'. *Journal of Nervous and Mental Disease.* 191(3). pp. 154–160.

Sharan, P., G. Chaudhary, S.A. Kavathekar and S. Saxena (1996) 'Preliminary report of psychiatric disorders in survivors of a severe earthquake'. *American Journal of Psychiatry.* 153(4). pp. 556–558.

Sireling, L., D. Cohen and I. Marks (1988) 'Guided mourning for morbid grief: a controlled replication'. *Behavior Therapy.* 19(2). pp. 121–132.

Taylor, S., K. Kuch, W.J. Koch, D.J. Crockett and G. Passey (1998) 'The structure of posttraumatic symptoms'. *Journal of Abnormal Psychology.* 107(1). pp. 154–160.

Wang, X. et al. (2000) 'Longitudinal study of earthquake-related PTSD in a randomly selected community sample in north China'. *American Journal of Psychiatry.* 157(8). pp. 1260–1266.